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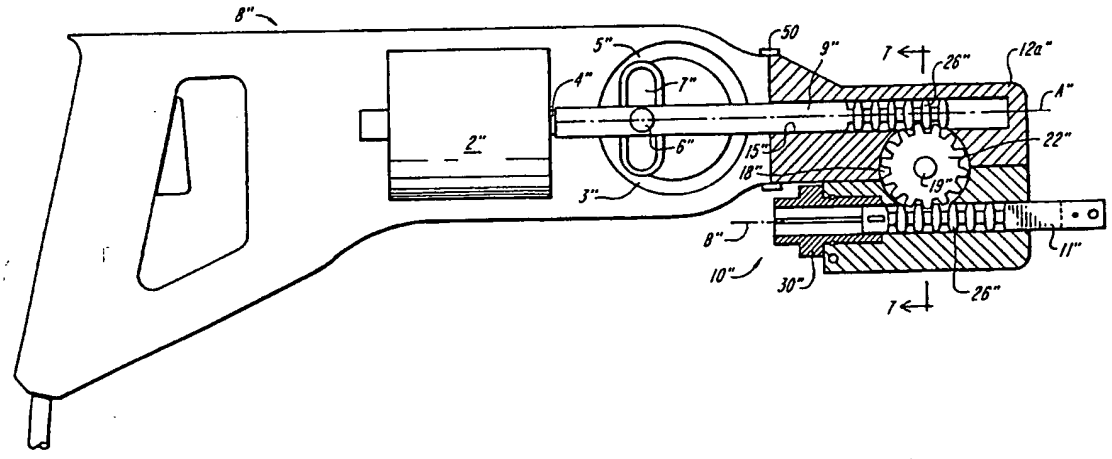

(57) Abstract

A reciprocating saw includes a system (10) that permits the saw blade to be mounted so that it is at an angle (i.e., so that it is not parallel) to the axis of reciprocation of the saw. The system (10) permits the blade (6) to be rotated about its axis of reciprocation, and in some embodiments the angle between the blade axis (B) and the axis of reciprocation of the saw (A) may be varied through an angle of about 90°.

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SAW ATTACHMENT

Field of Invention

This invention relates to reciprocating saws and, more particularly, to attachments for such saws.

Cross-Reference to Related Applications

This application is a continuation-in-part of U.S. Patent Application Serial No. 902,903 filed June 23, 1992.

Background of Invention

A reciprocating saw is one of the construction industry's most useful tools. Carpenters, plumbers, electricians, sheet metal workers and virtually all other tradesmen use the reciprocating saw. However, because the sawblade is axially aligned with the body of the saw, it is often difficult or awkward to cut, for example, in confined spaces close to walls or ceilings. Similar difficulties arise from the fact that the blade typically is also fixed relative to its long (reciprocating) axis.

Summary of Invention

The present invention permits the blade of a reciprocating saw to be mounted at an angle, e.g., 90°, to the output axis of the saw. In preferred embodiments, the axis of the blade can be adjusted to any angle within a range of about 90°, e.g. from parallel to

perpendicular, or from about 45° to about 135° relative to the saw output axis, and the blade also may be rotated 360° about both its own and the saws' reciprocating axes.

Description of Drawings

Figure 1 schematically illustrates an attachment constructed in accordance with the present invention mounted on a conventional reciprocating saw.

Figure 2 is a plan view, with one side plate, the saw blade and the tables removed, of the attachment of Figure 1.

Figure 3 is a plan view, partially in section, of the attachment of Figure 1.

Figure 4 is a section taken at line 4-4 of Figure 2.

Figures 5a and 5b are plan, partially schematic, views of a modified embodiment.

Figure 6 is a side view, partially in section, of a third embodiment of the invention.

Figure 7 is an end sectional view, taken at 7-7 of Figure 6.

Figure 8 is a top sectional view, taken at 8-8 of Figure 7.

Figures 9 and 10 are side views illustrating the operation of the embodiment of Figure 6.

Referencing to Figures 1-4, and particularly to Figure 1, there is shown a conventional reciprocating saw 8 (e.g., of the type manufactured and sold by Milwaukee Electric Tool Co. under the trade name "Sawzall") to which is connected in accord with the present invention. A conventional blade 6 is connected to attachment 10.

As illustrated, and conventionally, the output shaft 9 of saw 8 reciprocates on an axis A. Unconventionally, the output shaft 11 of attachment 10, and blade 6 which is connected to the attachment output shaft, reciprocate on a different axis B. In Figure 1, attachment 10 is constructed so that the blade axis B is substantially perpendicular, i.e., forms an angle of about 90°, to the axis A of reciprocation of the saw. In other embodiments, e.g., as shown in Figures 5a and 5b, the attachment, designated 10' in Figures 5a and 5b, is constructed so that the blade axis B may be pivoted relative to saw 8 to permit axis B to lie anywhere in the substantially 90° arc between lines B' (Fig. 5a; which forms an angle of about 45° with axis A) and B" (Fig. 5b; which forms an angle of about 135° with axis A). In both embodiments, the attachment 10 permits blade 6 to be rotated, either clockwise or counterclockwise about its longitudinal axis (coaxial with axis B) through a full 360°.

Attachment 10, shown most closely in Figures 2-4, comprises a housing 12, an input shaft 14, an output shaft 11, and a gear train coupling the input shaft 14 to the output shaft 11. In the embodiment of Figures 1-3, shafts 11 and 14 are mounted in respective bores 15 and 13, drilled into housing 12 perpendicular to each other. Bore 13 extends lengthwise of housing 12, from the end of the housing nearest saw 8 to about midway the length of housing 12. Bore 15 extends traversely through the housing 12, and includes a larger diameter countersink 16 at one end. Input shaft 14 is connected to the output shaft 9 of saw 8, and is mounted in cylindrical bore 13 for reciprocating movement on axis

A. Output shaft 11, to which the sawblade 6 is connected, is mounted in bore 15 for reciprocation on axis B.

The gear train connecting attachment input shaft 14 and output shaft 11 includes two primary gears 18, 20 of equal pitch and diameter, and an intermediate, smaller diameter, idler gear 22. Each gear is mounted in a drilled bore that extends through the thickness of housing 12, and is mounted for rotation on a respective shaft 19, 21, 23. The ends of shafts 19, 21 23 are, in turn, mounted in bearings in the face plates 24 on opposite sides of housing 12.

Each of attachment input and output shafts 11, 14 includes a cylindrical rack, the annular teeth 26 of which project radially outwardly and engage the teeth of the respective one of gears 18, 20. The annular gear tooth arrangement permits shafts 11, 14 to rotate 360° about their respective axes while remaining in engagement with the respective one of gears 18, 20. In the illustrated embodiment, gears 18, 20 have the same diameter so that the reciprocation rate and speed and the displacement of shafts 11 and 14 are the same. The relative displacements, reciprocation rate and speed, and power output, may, if desired, be changed by varying the relative diameters of the two gears.

For connecting attachment 10 to saw 8, the base plate of a conventional table 4 is bolted to a rotary support plate 46 at the end of housing 12 nearest saw 8, so that saw output shaft 9 and attachment input shaft 14 are in axial alignment. The side plate of table 4 are bolted to saw 8 in the conventional manner, e.g., by bolts or cap screws 5. AS will be evident, table 4 holds the body of saw 8 and housing of attachment 10 fixed relative to each other as the saw motor causes the

saw output shaft 9 and the input shaft 14 and output shaft 11 of attachment 10 to reciprocate. A second conventional table 2 is bolted to attachment 10 adjacent attachment output shaft, and is arranged so that saw blade 6 passes through the base plate of table 2 in the usual manner.

In some embodiments, support plate 46 may be welded to attachment 10, or support plate 46 may be omitted and base plate 3 of table 4 may be bolted or welded directly to the housing 12 of attachment 10. In the illustrated embodiment, support plate 46 is mounted on attachment 10 so that it can rotate about axis A relative to attachment 10. As shown in Figure 2, plate 46 includes an annular boss 48 slip fitted into a cylindrical countersink at the end of bore 13 nearest saw 8. Pins 50 extend through housing 12 on opposite sides of boss 48 and engage a groove in the outer periphery of boss 48. As will be evident, pins 50 both retain boss 48 in countersink 49 and permit plate 46 to rotate relative to attachment housing 12.

To retain attachment 10 in a desired rotational position, a keeper assembly 52 is mounted on one side of housing 12 and is arranged to engage the rim of plate 46.

The ends 27, 29 of shafts 14, 11 projecting outside housing 12 include flat apertured faces 26 and 28 arranged respectively to engage, so that shafts 14, 11 may be connected to, the output shaft 9 of saw 8 and blade 6.

Referring now to Figures 2 and 3, a blade rotator 30 is mounted in countersink 16 of bore 15. As shown, rotator 30 is coaxial with bore 15, and itself includes a through-bore 32 which has a diameter substantially equal to that of the major portion of bore 15 and forms

a slip fit with shaft 11. A projecting annular flange 34 on the outer end portion of rotator 30 engages the side 36 of housing 12. Rotator 30 is rotatable about its axis within bore 15 through a full 360°. A keeper assembly 40 is provided so that rotator 30 may be fixed in any desired rotational position. In the illustrated embodiment, keeper 40 includes a L-shaped member 41 arranged to engage the outer axially-facing surface of flange 34 and a cap screw 42 threaded into housing 12. When tightened, screw 42 holds member 41 tightly against flange 34; loosened, it permits rotator 30 to be turned 360 degrees around its axis.

An axial keyway 38 is cut in the inner wall of the bore 32 of rotator 30. Key 39 extends through the portion of shaft 11 within bore 32 and into keyway 38, permitting shaft 11 to reciprocate axially any relative rotation of the two. Thus, and as should be evident, rotator permits blade 6 to be rotated 360 degrees about its axis of reciprocation B, and to be fixed at any desired angle relative to the axis B. As the output shaft 11 reciprocates, keeper 40 holds the rotator, and this blade 6, in the desired angle to which rotator has been set.

Reference is now made to Figures 5a and 5b. As shown, somewhat schematically, the housing 12' of attachment 10' includes two portions, designated 12a' and 12b'. Portion 12b' is fixed between face plates 36'. Portion 12' is moveable between the two face plates between the position shown in Figure 5a in which the angle between axes A' and B' is about 135°, and that shown in Figure 5b which the angle between axes A' and B" is about 45°. Curved slots 60 in the face plates permit portion 12a', which as shown carries output shaft 11' and rotator 30', to be rotated through an about 90°

arc. Cap screws (not shown) extend through the housing and face plates and, when tightened, hold portion 12a' in any desired angular position.

Figures 6-10 illustrate a reciprocating saw 8" in which the system 10" for permitting the output shaft 11" to be pivoted relative to the saw's reciprocating output shaft 9" is part of the saw as manufactured, rather than an attachment. As shown, the saw motor 2" and gearing 3" for changing the rotary output of the saw motor to reciprocating output of shaft 9" is conventional. The rotating motor output shaft 4" turns a circular plate 5" around an axis perpendicular to the axis A" of shafts 4" and 9". A projecting boss 6" on shaft 9" engages an eccentric slot 7" on plate 5", so the rotation of plate 5" causes reciprocation of shaft 9".

In conventional saws, the sawblade is connected directly to the shaft 9" driven by motor 2" and gearing 3". In the illustrated embodiment, shaft 9" provides the input to system 10". As shown most clearly in Figures 6-8, system 10" includes a two-piece housing 12", the portion of shaft 9" that provides an input to the system, output shaft 11" to which the sawblade may be attached, and a coupling gear 22". Shaft 9" extends into a bore 15" drilled into one piece 12a" of housing 12" and includes a cylindrical rack the annular teeth 26" of which project radially outwardly and engage the teeth of gear 22". Output shaft 11" is mounted in a bore 13" drilled through the other piece 12b" of housing 12", and also includes a cylindrical rack having teeth 26" which engage the teeth of gear 22". When the two halves 12a" and 12b" of housing are in the relative orientations shown in Figures 6-8, the axes of bores 13", 15" (and hence those of shafts 9", 11") are off-set both vertically and horizontally from each other. Gear

22" is mounted in a drilled bore 18" that extends through the central portion of housing 12", and is mounted for rotation on a shaft 19" the ends of which are, in turn, mounted in bearings in the side faces 24" on opposite sides of housing 12". As will be seen, shaft 9" engages the top (as shown in Figure 6) of gear 22" near one end of the gear, while shaft 11" engages the bottom of gear 22" near its other end.

The two halves 12a", 12b" of housing 12 are rotatable relative to each other around the axis C" of gear 22", between the relative position shown in Figures 6-8 (in which the axes A", B" of shafts 9", 11" are parallel) to that shown in Figures 9 and 10 (in which the two axes A", B" are perpendicular). In the illustrated embodiment, the relative angular positioning of two housing halves is maintained by friction between their engaged inner faces; nuts 23" at the ends of shaft 19 are loosened to permit the two housing halves to be relatively rotated, and are then retightened to hold halves 12a", 12b" in position.

System 10" includes a blade rotator 30", substantially identical to that previously described with reference to the embodiment of Figure 1, to permit the shaft 11" (and hence a sawblade connected thereto) to be rotated about its axis of reciprocation B" and to be fixed at any desired rotational position.

The entire system 11" is also arranged for rotation, relative to saw 8" on and about the axis of reciprocation A" of shaft 9". As shown most clearly in Figures 9 and 10, housing half 12a" is connected to the housing of saw 8" by a split ring 50. Radially-inwardly projecting flanges on the opposite sides of ring 50 project into annular grooves on the outer surfaces of housing half 12a" and the housing of saw 8". A bolt 52

(shown in Figures 7 and 8) draws the ends of ring 50 tightly together to hold the housing 12" in the desired rotational position relative to saw 8", and is loosened to permit the housing and saw to be rotated (about axis A") into any desired relative rotational position.

Figures 9 and 10 illustrate the system 10" in two of such positions. In Figure 9, the housing 12" is bolted to the saw 8" in the same relative position as shown in Figure 1 (though, as previously mentioned, housing system 12b" has been rotated 90° relative to housing section 12a"). In Figure 10, housing 12" has been rotated 180° from the Figure 1 orientation.

Other embodiments will be within the scope of the following claims.

What is claimed is:

CLAIMS:

1. In a reciprocating saw having a body and a motor, that improvement comprising:

a first shaft arranged for connection to the motor of said saw and mounted for reciprocation, along a first axis, relative to said body in response to said motor of said saw;

a second shaft arranged for connection to a saw blade and mounted for reciprocation, along a second axis that is not coincident with, and that in at least one relative positioning of said first shaft said second shaft is not parallel to, said first axis; and

a drive connecting said first shaft to said second shaft so that reciprocation of aid attachment input causes reciprocation of said attachment output.

2. The improvement of claim 1 wherein said second axis is substantially perpendicular to said first axis when said shafts are in said at least one relative positioning.

3. The improvement of claim 1 wherein said second shaft is rotatable about said second axis, and including a retainer for holding said second shaft in a desired rotational position while permitting reciprocation of said second shaft along said second axis.

4. The improvement of claim 1 including a housing receiving said first shaft and supporting said second shaft and said drive, wherein said housing is rotatable about said first axis, and including a retainer for holding said housing in a desired rotational position.

5. The improvement of claim 1 wherein said first and second shafts are moveable relative to each other about a third axis generally perpendicular to said first and second axes to vary the angle between said first axis and second axis.

6. The improvement of claim 5 where said angle is variable in a range between about 45° and about 135°.

7. The improvement of claim 5 wherein said angle is variable in a range between about 0° and about 90°.

8. The improvement of claim 1 wherein each of said shafts comprises a rack of axially-spaced, radially-extending gear teeth extending circumferentially thereof, and at least one of said shafts is rotatable relative to said drive when in engagement with said drive.

9. The improvement of claim 1 wherein said drive includes a gear rotatable about an axis perpendicular to said first and second axes.

10. The improvement of claim 9 wherein said drive comprises an input gear engaging said first shaft, an output gear engaging said second shaft, and an idler gear engaging said input and output gears.

11. The improvement of claim 9 wherein said first and second shafts engage said gear.

12. The improvement of claim 1 including an attachment having a housing in which said first and second shafts and said drive are mounted, said housing being arranged for connection to the body of said saw.

13. The improvement of claim 12 wherein said saw includes a reciprocating output shaft, and said first shaft is connected to said output shaft.

14. The improvement of claim 12 wherein said first axis and said second axis are not parallel.

15. The improvement of claim 14 wherein the angle between said first axis and said second axis is in the range of about 45° to about 135°.

16. The improvement of claim 1 including first and second relatively rotatable housing sections, said first shaft being received in and reciprocable relative to said first housing section, said second shaft being received in and reciprocable relative to said second housing section, and said drive being received in and rotatable relative to both of said housing sections.

17. The improvement of claim 16 wherein said drive comprises a gear rotatable about a third axis perpendicular to said first and second axes, each of said first and second shafts engage said gear, and said first and second housing sections are relatively rotatable about said third axis.

18. The improvement of claim 17 wherein said housing sections are relatively rotatable about said third axis through an angle of not less than about 90°.

19. The improvement of claim 18 wherein said housing sections are rotatable relative to said saw about said first axis.

20. In combination:

a saw having a motor, a body and an output; and

a saw blade,

said saw having

a first shaft connected to the motor of said saw and mounted for reciprocation, along a first axis, relative to said body in response to said motor of said saw,

a second shaft connected to said saw blade and mounted for reciprocation, along a second axis that in at least one relative position of said first and second shafts is not parallel to said first axis, relative to said housing, and

a drive connecting said first shaft to said second shaft so that reciprocation of said output shaft in response to said saw motor causes reciprocation of said second shaft.

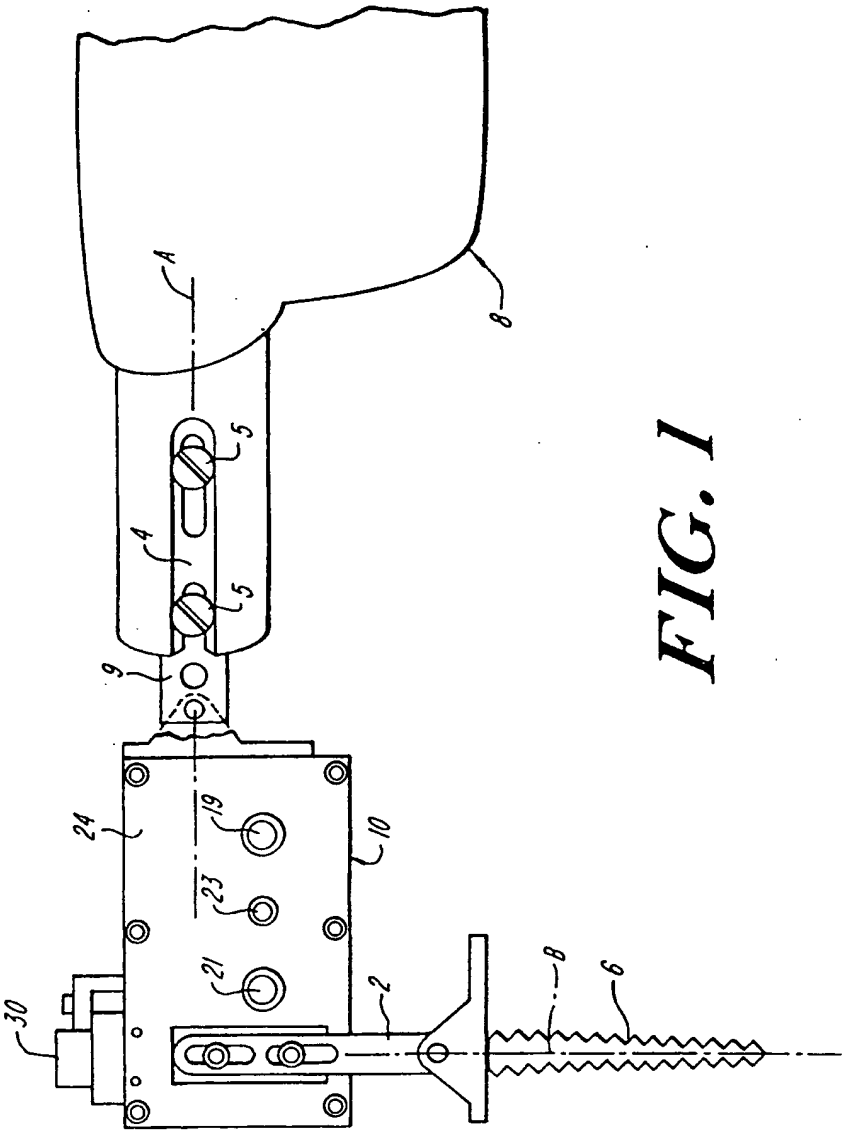

FIG. 1

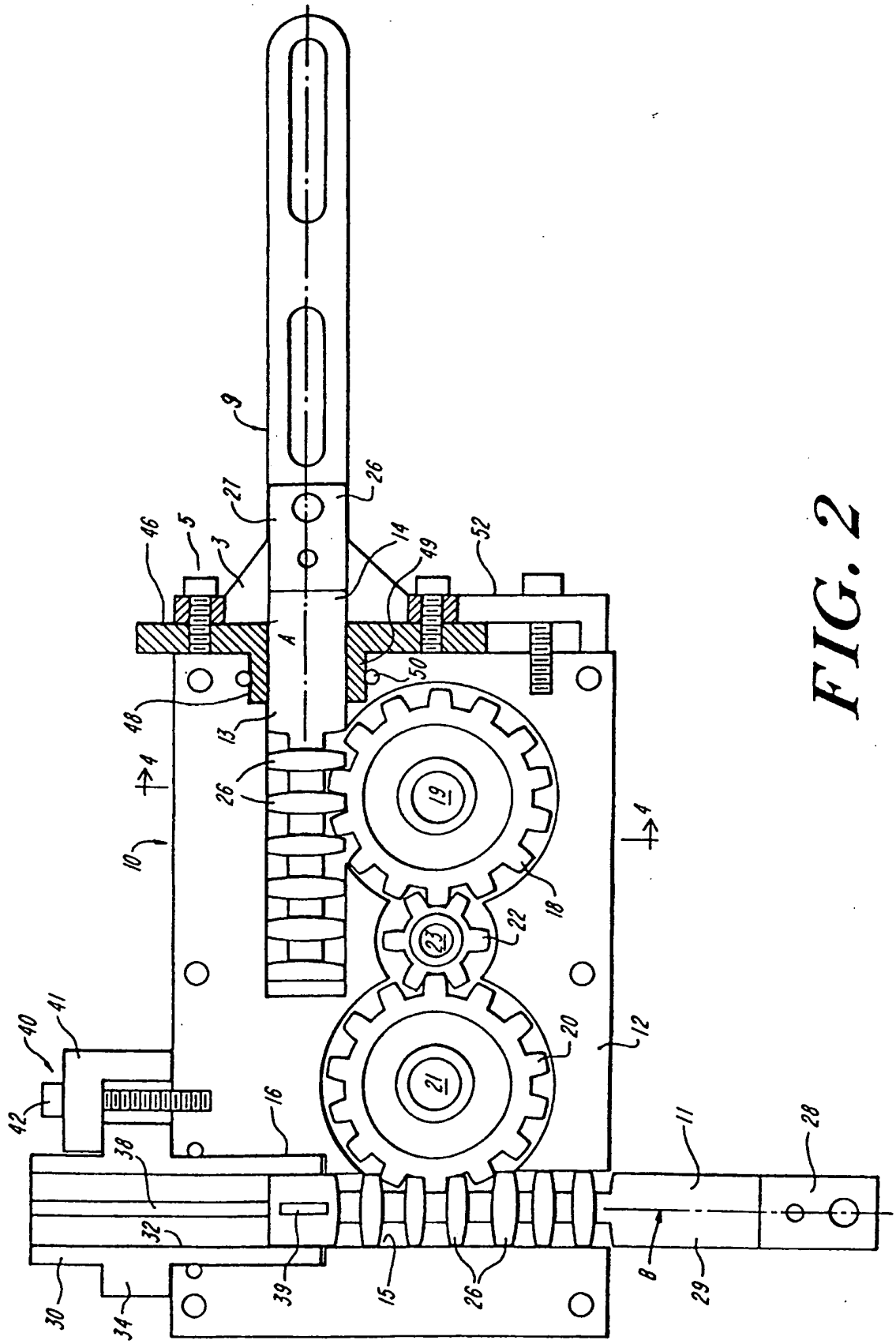
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FIG. 2

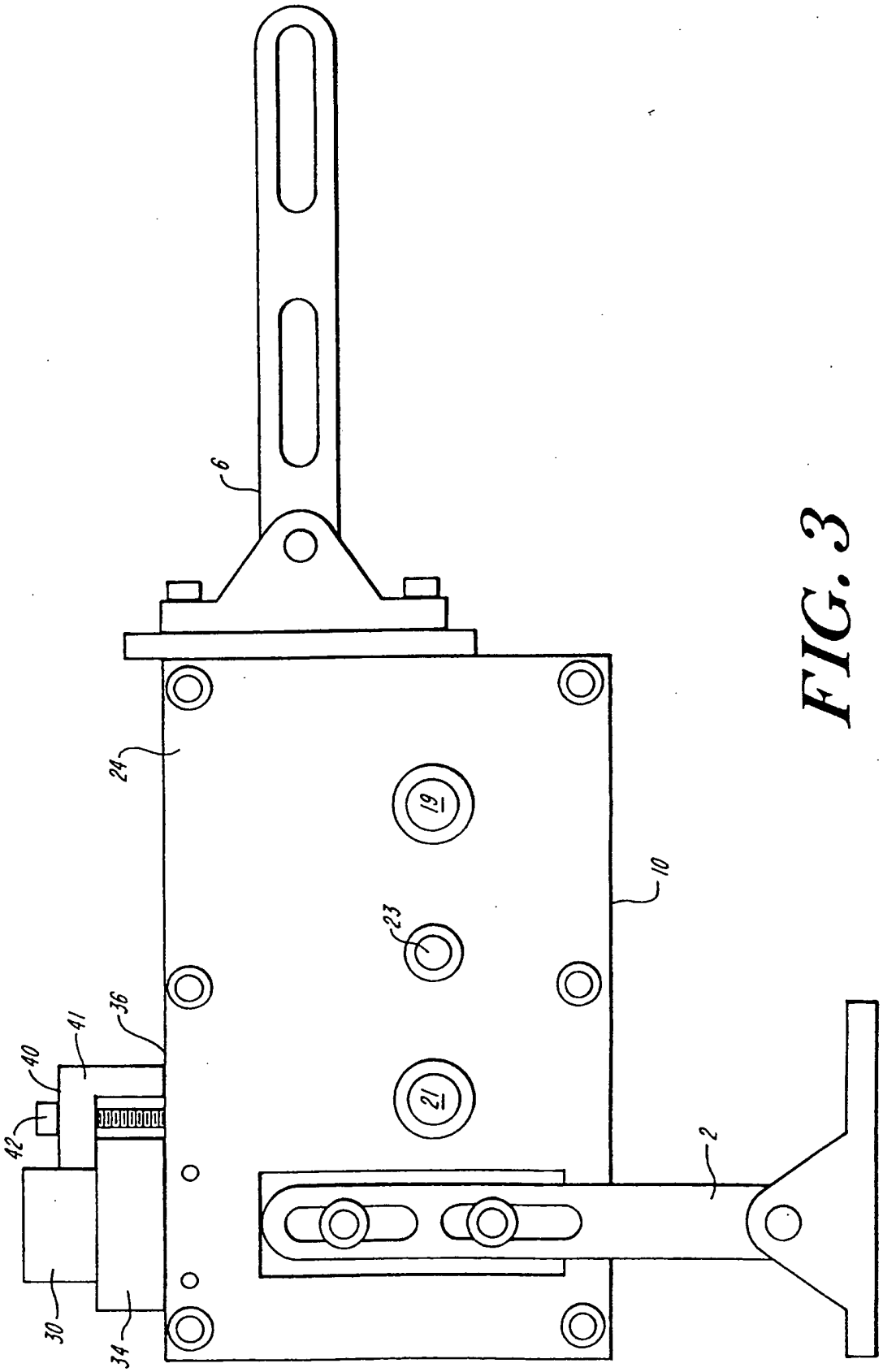

FIG. 3

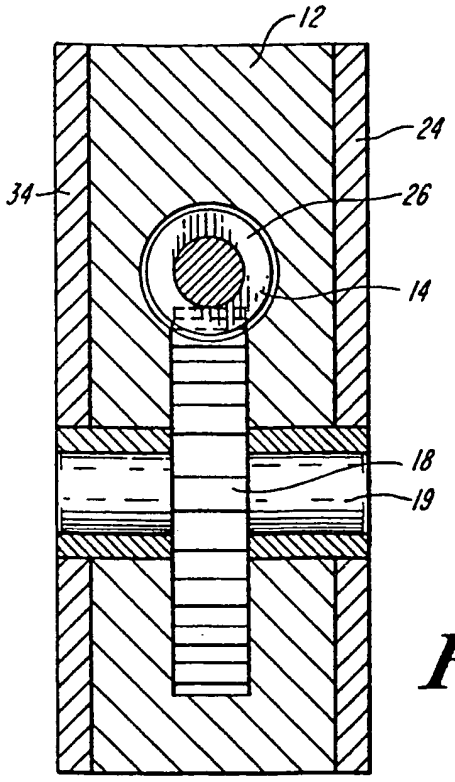

FIG. 4

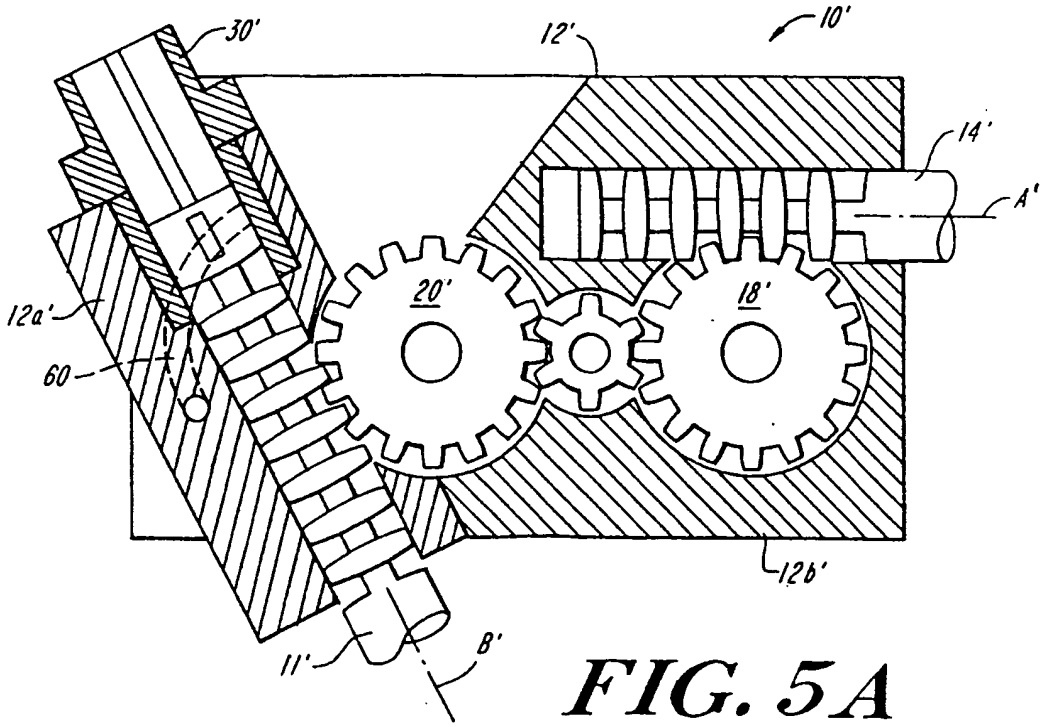

FIG. 5A

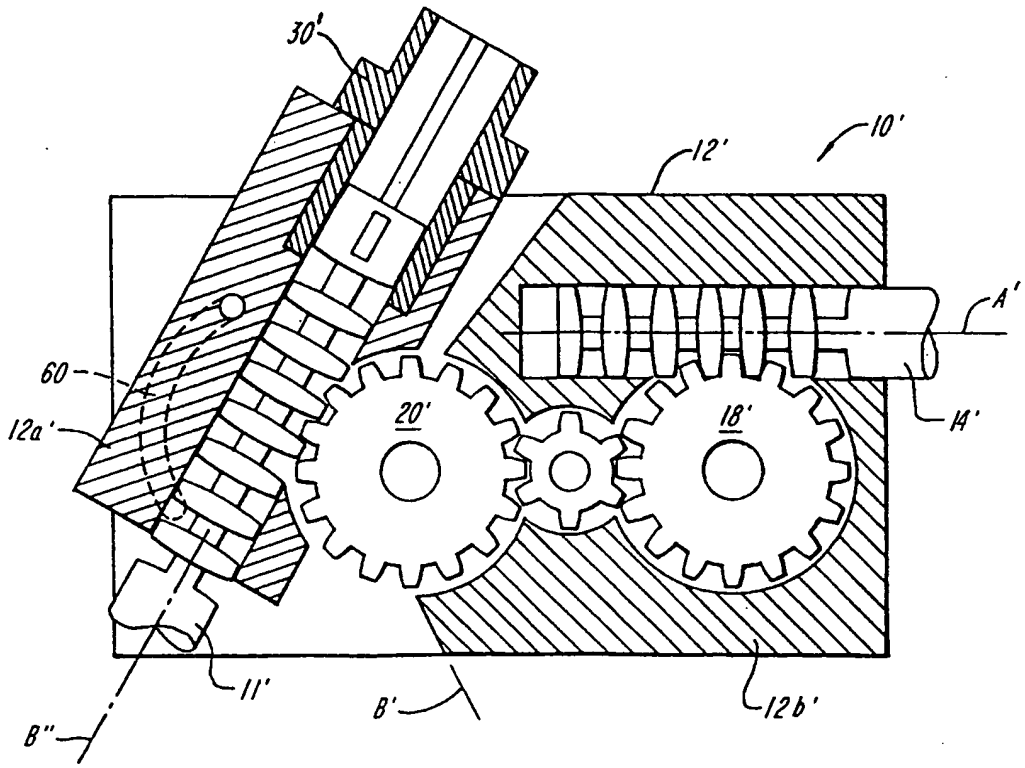

FIG. 5B

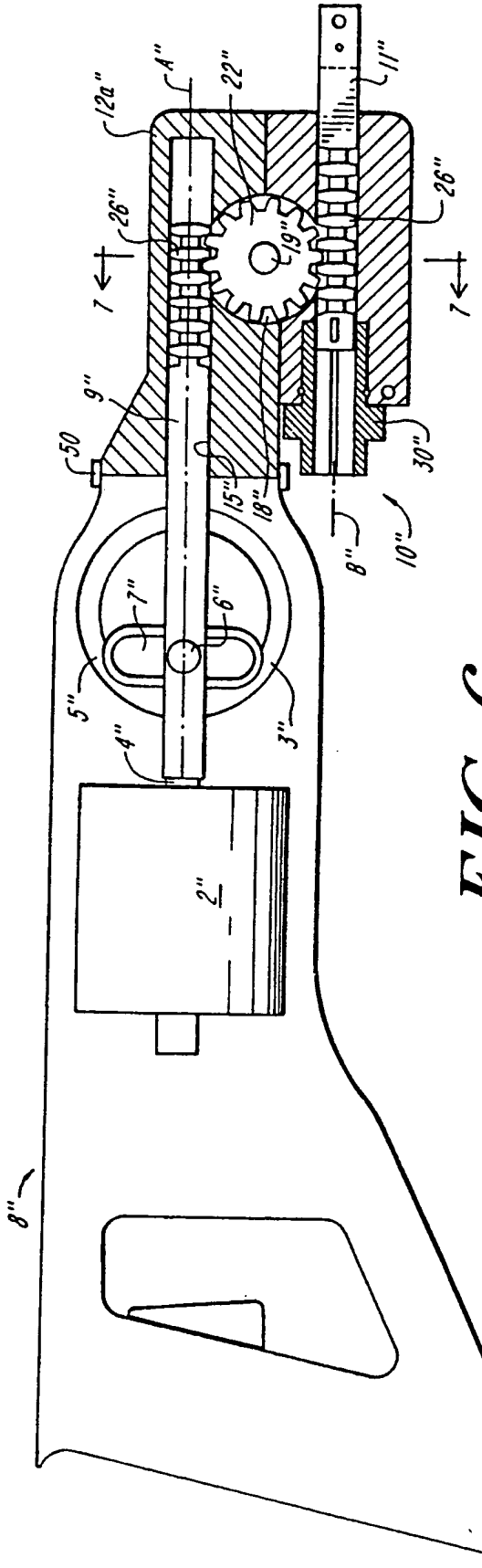

FIG. 6

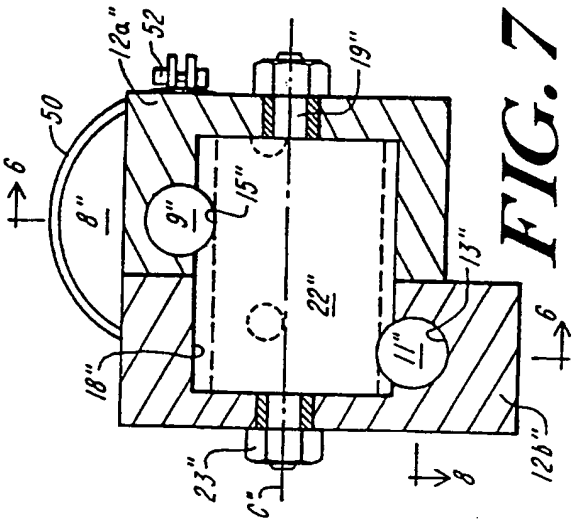

FIG. 7

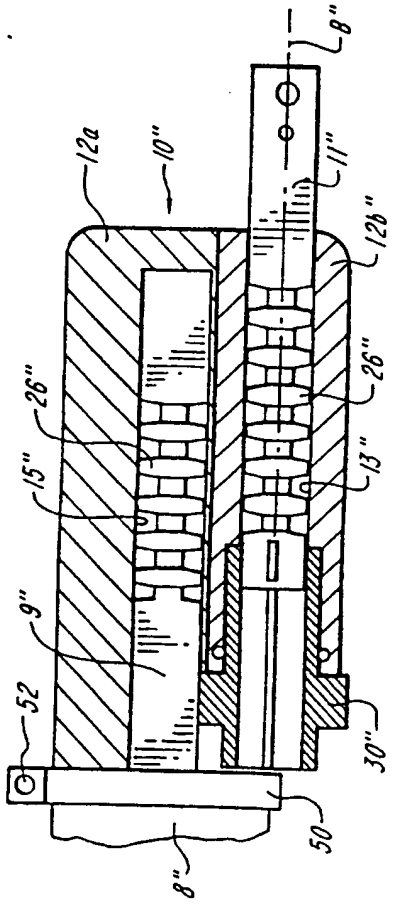

FIG. 8

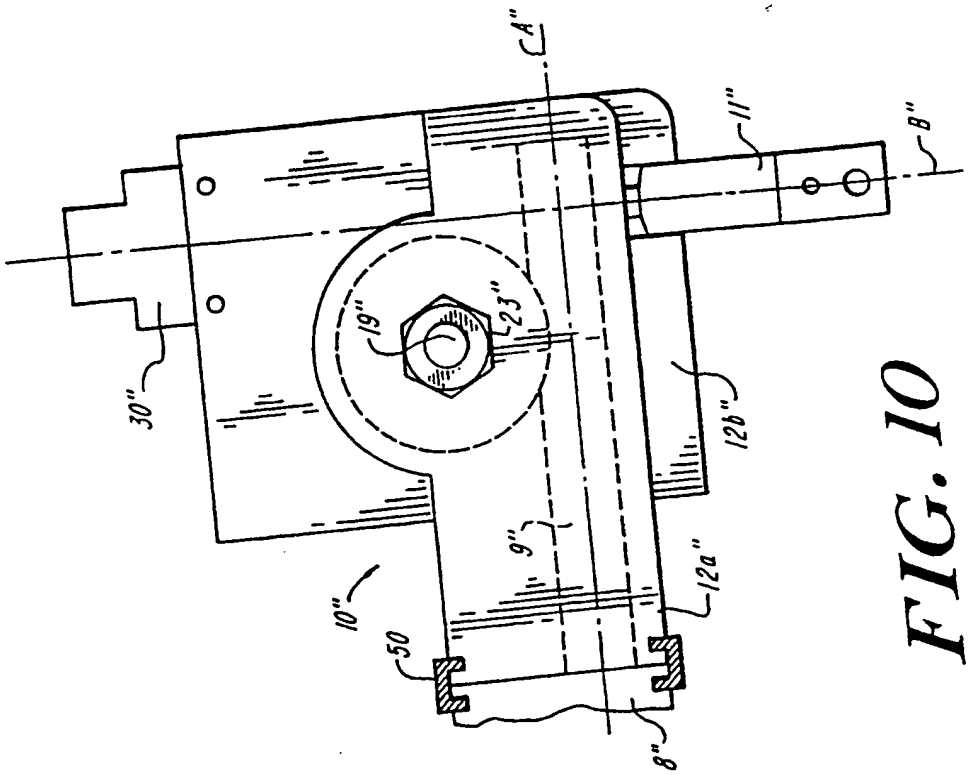

FIG. 10

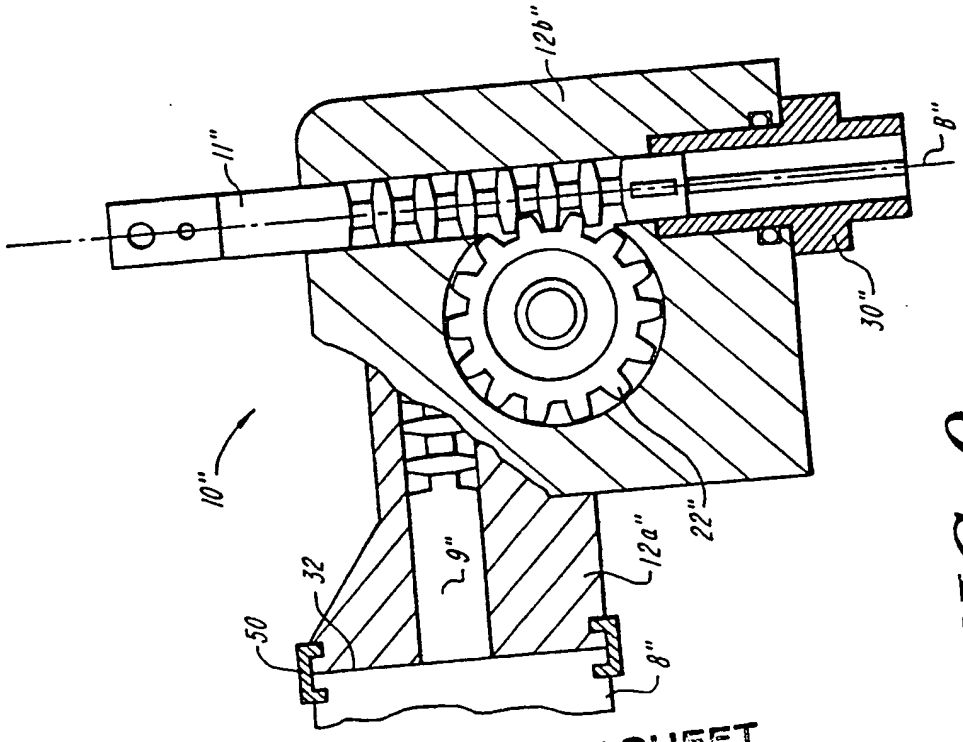

FIG. 9

INTERNATIONAL SEARCH REPORT

international application No.
PCT/US93/06001

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) : B23D 49/04, 57/00
US CL : 30/392,374

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 30/392,374

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	US,A, 5,193,281 (KASTEN) 16 March 1993 see entire document	1,2,4,5,7, 12,13,14, 19,20
A	US,A, 3,044,171 (CECERE) 17 July 1962 see entire document	1-20
A	US,A, 4,984,369 (FLINT et al) 15 January 1991 see entire document	1-20
A	US,A, 3,876,015 (KIVELA) 08 April 1975 see entire document	1-20
A	US,A, 2,822,005 (LEE et al) 04 February 1958 see entire document	1-20

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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Date of the actual completion of the international search
17 September 1993

Date of mailing of the international search report
06 OCT 1993

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INTERNATIONAL SEARCH REPORT

international application No.
PCT/US93/06001

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A, 2,668,567 (OLSON) 09 February 1954 see entire document	1-20